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Flow Visualization and Pattern Formation in Vertically Falling Liquid Films VEMURI BALAKOTAIAH, University of Houston, NIKOLAOS MALAMATARIS, George Mason University — Analytical results of a low-dimensional two equation h-q model and results of a direct numerical simulation of the transient two-dimensional Navier Stokes equations are presented for vertically falling liquid films along a solid wall. The numerical study aims at the elucidation of the hydrodynamics of the falling film. The analytical study aims at the calculation of the parameter space where pattern formation occurs for this flow. It has been found that when the wave amplitude exceeds a certain magnitude, flow reversal occurs in the film underneath the minimum of the waves [1]. The instantaneous vortical structures possess two hyperbolic points on the vertical wall and an elliptic point in the film. As the wave amplitude increases further, the elliptic point reaches the free surface of the film and two more hyperbolic points are formed in the free surface that replace the elliptic point. Between the two hyperbolic points on the free surface, the streamwise component of velocity is negative and the film is divided into asymmetric patterns of up and down flows. Depending on the value of the Kapitza number, these patterns are either stationary or oscillatory. Physical reasons for the influence of the Kapitza number on pattern formation are given. Movies are shown where the pattern formation is demonstrated. [1] N.A.Malamataris and V.Balakotaiah (2008), AIChE J., 54(7), p. 1725-1740

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